IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: **KAMENOFF**	)	
	)	Examiner: A. Boateng
Serial No. **10/694,635**	)	
Filing Date: **October 27, 2003**	)	
Confirmation No. **2632**	)	Art Unit: 2838
For: **BATTERY HEATING CIRCUIT**	)	

DECLARATION OF PHILIP PERREAULT UNDER 37 C.F.R. §1.132

Mail Stop Amendment
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, **PHILIP PERREAULT**, do hereby declare as follows:

1. I am the President of Mathews Associates, Inc., the Assignee of the above-identified patent application. I was also the direct supervisor of the inventor, Robert Kamenoff, at the time he invented the claimed subject matter set forth in this patent application.

2. Mathews Associates, Inc. is in the business of manufacturing military and commercial batteries.

3. A customer approached us and asked us if we could develop a special battery for them. They were developing a survival radio intended for use by stranded military personnel to assist in their rescue. The radio had to transmit information about the survivor in very short high energy bursts.

Further, the radio had to work at very low temperatures. As the radio development progressed the customer discovered that there was no available battery that could provide the high power bursts at the low temperatures. In short, the radio performance was severely limited for lack of an adequate battery.

4. The initial requirements were for a battery that would supply short duration 18 watt pulses of power to the radio at an ambient temperature of -29 degrees C (-20F). Customer demands for radio performance soon pushed the battery requirements to 26 watt pulses of power to the radio at an ambient temperature of -40 degrees C (-40F).

5. It was obvious from the onset that contemporary battery technology could not meet these battery requirements. The internal resistance of cells or batteries increases significantly at lower temperatures thereby lowering the battery terminal voltage, particularly under periods of high loads. The survival radio had a minimum operating voltage, commonly called "Cut-off Voltage". The reduced terminal voltage at lower temperatures caused the radio to reach its cut-off voltage prematurely while the cell or battery had much remaining stored capacity. This phenomenon became dominant at the lower 10 or so degrees centigrade of the cell or batteries specified operating temperature range. Contemporary batteries were capable of delivering less than 10 percent of their total capacity to the radio.

6. In response, I instructed Robert Kamenoff to develop a self-heating battery to overcome this problem. A discharge current sensor, temperature sensor, and a heater are built into the battery. The temperature sensor detects when the cell or battery temperature is below the temperature where available capacity is severely limited (typically 10 or so degrees Centigrade above the minimum specified operating temperature of the cell). The sensor turns on an internal battery heater that raises the temperature enough so that the battery can deliver most of its rated capacity. The discharge current sensor is used to lock out the heater when the battery is not in use so as to prevent the heater from discharging the battery when stored at cold temperatures.

7. During the early stage of the development we realized that during the short duration high energy pulse demand the energy that was being consumed by the heater was energy that could not be supplied to the radio. To overcome this, the discharge current sensor is used to turn off the heater when the discharge current is high. This ensures that the entire available energy from the battery will be delivered to the load during periods of peak demand.

8. While this heater consumes only a small percentage of the total battery capacity, it enables the battery to deliver most of its total capacity at its minimum specified operating temperature.

9. Also, charge protection is required for primary military batteries. Contemporary charge protection technology utilized diodes in series with each string of cells or batteries to prevent charging. While the use of diodes did perform the intended function it had a significant drawback. The charge protection diode typically had a forward drop or loss of 300 to 500 milli-volts further reducing the battery terminal voltage.

10. An electronic circuit was developed that minimized this diode loss. The diode has been replaced with a field effect transistor and an operational amplifier that is used to sense the current through the FET by measuring its voltage drop. When the battery is in a quiescent state, the op-amp senses no voltage across the FET (no current through it) and biases the FET off.

11. If a charge potential is applied to the battery, the FET is off and its inherent diode is reversed biased insuring that no charge current can flow. When a load is applied to the cell or battery, discharge current begins to flow through the inherent FET diode. The op-amp senses the forward voltage drop of the diode. When the drop exceeds a few milli-volts the op amp turns the FET on, clamping its forward drop to a few milli-volts. The net effect is that the new charge protection has nearly zero effect on the battery terminal voltage.

12. A lab test was conducted on two batteries. They were identical cases with identical cells. One battery had none

of the above enhancements while the other did not. They were discharged per the radio requirement of a repeated cycle of 1.8 watts for 267 seconds followed by 7.2 watts for 30 seconds followed by 26 watts for 3 seconds until the cut-off voltage was reached. The ambient temperature was -40 C (-40F).

13. The operating time for the battery without the heating enhancement was less than 5 minutes and it was not capable of supplying the 26 watts at all. The enhanced battery operated for 4.5 hours before the cut-off voltage was reached.

14. To date the battery that we have developed with this advanced technology is the only battery that can meet all the requirements of the radio.

15. I hereby declare that all statements made herein are of my own knowledge and are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title XVIII of the United States Code, and that such willful and false statements may jeopardize the validity of the application or any patent issued thereon.

6-8-2007
Date

Philip Perreault
PHILIP PERREAULT